

## **What is claimed is:**

**[Claim 1]** 1. A progressive decoding method for decoding a bit-stream signal into an image data, the bit-stream signal having a plurality of scans, the progressive decoding method comprising:

receiving the scans according to a predetermined sequence;  
decoding each of the scans into a partial decoded pixel and a non-zero indicator, wherein the non-zero indicator represents whether or not an encoding coefficient of the current decoded scan corresponds to a non-zero value; and  
summing the partial decoded pixel generated from each of the scans according to the predetermined sequence, and updating a non-zero history with the non-zero indicator.

**[Claim 2]** 2. The progressive decoding method of claim 1 wherein when all of the scans are processed, a plurality of integral decoded pixels are generated from summing partial decoded pixels generated from the scans, and the integral decoded pixels form the image data.

**[Claim 3]** 3. The progressive decoding method of claim 1 wherein the bit-stream signal is a progressive JPEG bit-stream signal, and the image data is a JPEG image data.

**[Claim 4]** 4. The progressive decoding method of claim 1 further comprising:

down-sampling the partial decoded pixel generated from each of the scans for generating a partial down-sampling decoded pixel; and

summing up the partial down-sampled decoded pixel generated from each of the scans and according to the predetermined sequence, and updating a non-zero history with the non-zero indicator,.

**[Claim 5]** 5. A progressive decoding method for decoding a bit-stream signal into an image data, the bit-stream signal comprising a plurality of scans, the image data being generated after all of the scans are processed with the progressive decoding method, the progressive decoding method comprising:

- (a) receiving a scan;
- (b) determining whether the scan is the first scan of the scans; if it is, progressing to step (c); if it is not, progressing to step (d);
- (c) decoding the scan into a partial decoded pixel and a non-zero history;
- (d) decoding the scan into a partial decoded pixel and a non-zero indicator, wherein the non-zero indicator represents whether or not an encoding coefficient of the current decoded scan corresponds to a non-zero value; progressing to step (e);
- (e) summing up the partial decoded pixel and a previously summed partial decoded pixel and updating the non-zero history with the non-zero indicator.

**[Claim 6]** 6. The progressive decoding method of claim 5 further comprising:

- (f) determining whether the scan is the last scan of the scans after steps (c) or (e), and if it is, stopping performing the progressive decoding method.

**[Claim 7]** 7. The progressive decoding method of claim 5 being performed by a progressive decoder having a memory device, wherein the progressive decoding method further comprises:

- (g) before step (e), retrieving the previously summed partial decoded pixel and the previously generated non-zero history from the memory device; and

(h) after step (e), storing the newly summed partial decoded pixel and the newly updated non-zero history into the storage device.

**[Claim 8]** 8. The progressive decoding method of claim 7 wherein the decoder further comprises a processing unit electrically coupled to the storage device, and the processing unit is used for receiving the scans of the bit-stream signal, performing the progressive decoding method, and outputting the image data.

**[Claim 9]** 9. The progressive decoding method of claim 5 wherein when all of the scans are processed, a plurality of integral decoded pixels are generated from summing partial decoded pixels generated from the scans, and the integral decoded pixels form the image data.

**[Claim 10]** 10. The progressive decoding method of claim 5 wherein the bit-stream signal is a progressive JPEG bit-stream signal, and the image data is a JPEG image data.

**[Claim 11]** 11. A progressive decoding method for decoding a bit-stream signal into an image data, the bit-stream signal having a plurality of scans, the image data being generated after each of the scans is processed by the progressive decoding method, the progressive decoding method comprising:

- (a) receiving a scan;
- (b) determining whether the scan is the first scan of the scans; if it is, progressing to step (c); if it is not, progressing to step (e);
- (c) decoding the scan into a partial decoded pixel and a non-zero history;
- (d) after step (c), down-sampling the partial pixel for generating a partial down-sampled decoded pixel;
- (e) decoding the scan into a partial decoded pixel and a non-zero indicator, wherein the non-zero indicator represents whether or not an encoding coefficient of the current decoded scan corresponds to a non-zero value;

(f) after step (e), down-sampling the partial decoded pixel for generating a partial down-sampled decoded pixel; and  
(g) after step (f), summing up the partial decoded pixel and a previously summed partial down-sampled decoded pixel, and updating the non-zero history with the previously generated non-zero indicator.

**[Claim 12]** 12. The progressive decoding method of claim 11 further comprising:

(h) determining whether the scan is the last scan of the scans after steps (d) and (g), and if it is, stopping performing the progressive decoding method.

**[Claim 13]** 13. The progressive decoding method of claim 11 being performed by a progressive decoder having a storage device, wherein the progressive decoding method further comprises:

(i) before step (g), retrieving the previously summed partial down-sampled decoded pixel and the previously updated non-zero history from the storage device; and

(j) after step (g), storing the newly summed partial down-sampled decoded pixel and the newly updated non-zero history into the storage device.

**[Claim 14]** 14. The progressive decoding method of claim 13 wherein the decoder further comprises a processing unit electrically coupled to the storage device, and the processing unit is used for receiving the scans of the bit-stream signal, for performing the progressive decoding method, and for outputting the image data.

**[Claim 15]** 15. The progressive decoding method of claim 13 wherein the decoder further comprises a filtering device for performing step (c) and step (f).

**[Claim 16]** 16. The progressive decoding method of claim 11 wherein when all of the scans are processed, a plurality of integral decoded pixels are generated from summing partial decoded pixels generated from the scans, and the integral decoded pixels form the image data.

**[Claim 17]** 17. The progressive decoding method of claim 11 wherein the bit-stream signal is a progressive JPEG bit-stream signal, and the image data is a JPEG image data.

**[Claim 18]** 18. A progressive decoder for decoding a bit-stream signal into an image data, the bit-stream signal having a plurality of scans, the progressive decoder comprising:

a processing unit for receiving the scans in a predetermined sequence, decoding each of the scans into a partial decoded pixel and a non-zero indicator according to the predetermined sequence, summing the partial decoded pixels generated from each of the scans according to the predetermined sequence, updating a non-zero history with the non-zero indicator each time a scan being decoded, and outputting the image data, wherein the non-zero indicator represents whether or not an encoding coefficient of the current decoded scan corresponds to a non-zero value; a storage device for storing a summed partial decoded pixel and the non-zero history; and

a memory management unit electrically coupled to the storage device and the processing unit for controlling the storage device.

**[Claim 19]** 19. The progressive decoder of claim 18 further comprising a filtering device in the processing unit for down-sampling the partial decoded pixel generated from each of the scans to generate a corresponding partial down-sampled decoded pixel.

**[Claim 20]** 20. The progressive decoder of claim 18 further comprising a display unit electrically coupled to the memory management unit for displaying the image data.